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(54) **Method and device for improving milk secretion of cattle.**

(57) One or more gastric resident object (7) are admitted into the rumen of dairy cattle for giving physical stimuli to the rumen, so that the milk secretion of the dairy cattle can be increased and prevented from being decreased when the scorching heat of summer, permitting energy source of fibrous feed to be supplemented with other feed. Consequently, VFA can be naturally yielded, and the total intake energy the cattle ingests can be increased.

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This invention relates to a method for improving the milk secretion of dairy cattle, and a device for administration of a gastric resident object into the rumen of the cattle to improve the milk secretion.

Fibrous livestock feed rich in crude fiber such as straw, pasture and soiling crop is generally called roughage in contradistinction to concentrate, and has been given as mineral nutrients to dairy cattle. The feed of this kind for cattle covers about 50% of calcium and magnesium, and 95% of potassium of the caloric intake that a well-milking cow capable of yielding 9000 kg of milk a year needs per year. The nutritious roughage can supply the dairy cattle with as much as 50% of respective protein and energy in the required caloric intake for the cattle.

Long dietary fibers which cannot be substituted with any other feed have functions of encouraging rumination and salivation of the cattle and preserving pH value in the first compartment of the stomach (rumen) by the buffer action of NaHCO, contained in saliva, thus propagating microorganisms.

In particular, the dietary fibers which are cut longer as a feed for cattle intertwine with one another to be formed in a mat in the rumen. The mat-like fibers stimulate the rumen, thereby causing the rumen to move peristaltically. As a result, the fibers grow to feed lumps, giving rise to rumination. Meanwhile, small granular feed fragments such as cereals are sufficiently affected by the decomposition of the microorganisms parasitic in the rumen under the care of a rumen mat, thus to increase digestibility. Consequently, the suitable volume of the rumen mat is effective in increasing the digestibility of dietary fibers and starch and the cream content in the milk secreted by the dairy cattle and preventing displacement of the abomasum.

By maintaining fibrous feed of decomposition-retardant carbohydrates and starchy feed of decomposable carbohydrates at a predetermined ratio, VFA is deterred from being brought forth quickly in large quantities in the rumen. As a result, the pH value in the rumen can be prevented from being lowered. Incidentally, when the pH value becomes less than 5.5, the number of microorganisms aiding to the digestion is sharply decreased. The indigestible dietary fibers have a function of excreting body wastes produced by metabolism.

Since the amount of milk secreted by a milking cow depends on dry matter intake, increase of the content of dry matters is most essential to elevate the milk secretion of the milking cow. Accordingly, it is desirable to increase the number of times of feeding the milking cow and cut the dietary fibers as short as possible. Another measure for elevating the milk secretion has been contrived by increasing the water content of the livestock feed. When the percentage of the water content in the entire feed for cattle is 55% to 65%, the amount of dry matters the cow ingests becomes the largest. Because such moist feed is effective in letting the dairy cattle have nutriments, the feed for cattle is usually supplied with moisture. (Incidentally, natural grass contains much dry matters as compared with hay.)

The amount of dry matters that the milking cow ingests generally is 3.5% to 4% of its body weight, but yet a well-milking cow may ingest more.

The dairy cattle chiefly feeds on roughage. The feed for dairy cattle generally contains 63% to 65% of roughage and 37% to 35% of concentrate. On the other hand, the feed for beef cattle generally consists of 20% to 10% of roughage and 80% to 90% of concentrate. The guidelines of fibrous feed required for raising the dairy cattle according to NRC 1988 are as follows:

TABLE 1

	Crude Fiber	ADF	NDF
Milking Cow	>17%	21%	28%
Guidelines in milking well	>17%	19%	25%
Fat Cow	>9%	>12%	<18%
Rearing Cow	15%		

ADF..Acid detergent fiber
NDF..Neutral detergent fiber

The crude fiber belongs to dietary fibers insoluble in acid and alkali. Since the crude fiber contains the whole of cellulose and parts of hemicellulose and lignin, digestible constituents and indigestible constituents of the dietary fibers cannot be definitely identified. In general, these constituents are distinguished by a detergent analysis or an enzymatic decomposition analysis.

The microorganisms in the rumen of the milking cow have a function of decomposing particularly carbohydrates in the feed to yield VFA (volatile fatty acid). The VFA is absorbed into the organic system through the stomach walls of the rumen and turned into physical energy of the milking cow. The physical energy thus obtained comes to about 60% of the required energy for the milking cow.

The kind and content of VFA produced in the rumen influence the milk secretion and contents in the milk. The relation among the carbohydrates in feed, produced VFA, and milk components is shown in Table 2 below.

TABLE 2

Carbohydrates	Ferments in Rumens	Milk Contents
Fibers (NDF34~36%, ADF21%, CF17%) →	Acetic Acid →	Cream Milk Yield
Starch (20~25%) →	Propionic Acid (25%) →	Lactose Milk Protein
Sugar → (also → Propionic Acid)	Butyric Acid (10%) →	Cream

In general, the percentage of VFA produced in the rumen is 40% to 70% of acetic acid, 20% to 30% of propionic acid, 10% to 15% of butyric acid, and 0% to 5% of others.

There is a relation between the feed and VFA such that the acetic acid increases as the dietary fiber content increases, and the propionic acid increases as the starch content increases. The sugar content increases as the amount of lactose increases.

On the relation between the VFA and the milk components, the cream content increases as the acetic acid increases. and the milk protein increases as the butyric acid increases. Although the cream content increases with increasing the butyric acid, the yield of butyric acid is generally smaller than that of acetic acid.

The cream content decreases with increasing the ratio of the acetic acid to the propionic acid (A/P ratio). To keep the cream content at 3.5% or more, it seems that the A/P ratio should be 2 or more.

Thus, feeding of roughage for the dairy cattle is essential to supply nutrition to the cattle, stimulate the rumen and enhance excretion, but involves many problems to be solved.

The physical energy excreted with excrement comes to 30% to 50% of the total energy (GE) held in the feed. The more the content of roughage in the feed is, the more the physical energy in the excrete is. The net energy (NE) is expressed as the amount obtained by excluding the excrement, urine, marsh gas, and caloric increment from GE. (The digestible energy (DE) is given by excluding the excrement from the total energy GE, and the net energy NE is given by excluding urine, marsh gas, and caloric increment from DE.) The caloric increment is the energy produced by fermentation heat and metabolism of nutriments and amounts to 5 - 10% of GE.

The increase in fermentation heat becomes conspicuous with increasing the content of dietary fiber in the feed. A close relation exists between the energy level of the feed and the content of dietary fiber in the feed. That is, increase of the dietary fiber in the feed involves decrease of the total energy level of the feed.

The aforenoted relation between the energy level and the fiber content in the feed results from the composition of the roughage (fibrous feed) consisting of cellulose, hemicellulose and lignin. The cellulose and hemicellulose which fulfill a physical function of the roughage are fermentatively decomposed so that physical energy is produced while increasing caloric energy and metabolic calories, thereby causing energy loss. Particularly, the indigestible lignin produces no positive energy, but it turns into negative energy when passing through the alimentary canal, resulting in large energy loss. Accordingly, it is desirable to choose the fibrous feed low in lignin content.

Thus, since the roughage is important to the milking cow from the standpoint of physiology of the digestive system, the milking cow necessitates habitual ingestion of a prescribed amount of the dietary fibers. The suitable roughage to be fed to the milking cow desirably contains more than 17% of crude fiber, and more than 21% of ADF. However, there is an antinomic relation between the fiber content and the whole energy level of the feed such that the energy level is lowered by increasing the fiber content in the feed, with the result that the yield of milk is decreased.

The dry matter intake, i.e. the total energy intake, affords the key to improvement in milk secretion of the milking cow. To improve the milk secretion, it is important to increase the total energy to be supplied to the milking cow. However, the roughage has a cause of impeding the milk secretion.

There have been taken various measures to solve the problems mentioned above. For instance, the roughage is subjected to an enzymatic analysis to be classified into digestible fibers referred to as "Class Oa" and indigestible fibers referred to as "Class Ob". Upon evaluating the result of the analysis, attempts have been made to chiefly use the roughage rich in Class-Oa fiber as much as possible and take care not to use the roughage rich in Class-Ob fiber, so as to ensure ingestion of feed having sufficient fiber content. In another way for improving the milk secretion, the dietary fibers are cut as short as possible, or soaked in water to get moist, so that the milking cow ingests lots of dry matters.

Furthermore, feeding of the roughage involves many problems in connection with the above, as follows:

① Economic problem: The roughage is expensive in unit price per total volume of digestible nourishment as well as dry matters in comparison with the concentrate.

② Reception and storage of the feed become onerous, and automation and mechanization of the work of feeding are difficult due to the restriction of the properties of roughage. The work of feeding the roughage requires much time and labour and proves to be troublesome, thus costing a great deal.

③ The amount of excretion is disadvantageously increased according to the amount of indigestible fibrous components such as lignin which the cow fed on.

Accordingly, the present invention has an object to improve the milk secretion of ruminant dairy cattle, without contradicting use of dietary fibers of all kinds indispensable to the cattle, by choosing only fibrous feed rich in digestible fibers belonging to "Class Oa" from fibrous feed (roughage), but refraining from using fibrous feed containing plenty of indigestible fibers belonging to "Class Ob". According to another method of the present invention, the milk secretion of the dairy cattle and the milk content in the milk secreted by the cattle can be increased while reducing the amount of roughage to be fed to the cattle to half of the amount of roughage required conventionally and using a physical substitute for roughage without decreasing energy level of the feed. The physical substitute to be admitted into the rumen of the cattle comprises a core, and stimulating elastic members radially extending from the core. By positioning the physical substitute in the rumen of the cattle, the fiber content in the feed can be decreased, and the concentration of acetic acid in VFA can be maintained adequately.

One way of carrying out the invention is described in detail below with reference to drawings which illustrate only one specific embodiment, in which:-

Figure 1 is a cross sectional view of the gastric resident object according to this invention, Figure 2 is an enlarged perspective view showing in part the gastric resident object of Figure 1, Figure 3 is an exploded perspective view of the gastric resident object of Figure 1, in use, and Figure 4 through Figure 8 are graphs of characteristics of milk secretion improved by use of the gastric resident object according to the invention.

The roughage has two functional factors. One of the factors serves as nutritive elements including vitamins, minerals, cellulose, and hemicellulose. The other factor has functions of bringing about rumination by giving physical stimuli to the mucous membrane of the rumen, and forming and preserving ruminal papillae.

The former functional factor can be substituted by other possible feed. In actual fact, different feed was used in place of the roughage as occasion demands when practicing the method of this invention. The latter functional factor could be attained by devising a gastric resident object capable of fulfilling the desired physical action. As the result of the experiment the inventor actually conducted, an excellent effect of the method according to the invention could be proved.

The present invention will be described hereinafter with reference to the accompanying drawings. The gastric resident object 7 according to the invention comprises a core 71 formed by twisting two wires between which a large number of stimulating elastic members 72 are held fixedly. The stimulating elastic members 72 are formed of a nylon fiber in this embodiment, but may be made of a natural fiber, synthetic string or other linear materials.

The stimulating elastic members 72 extend radially from the core 71 into a substantially cylindrical or spherical spiny shape. A nylon fiber of about 0.7 mm in diameter can be preferably used as the stimulating elastic member 72. However, the diameter of the stimulating elastic member is not specifically limited, and may be suitably determined in accordance with the stiffness and other conditions of the stimulating elastic member.

Although the core 71 in this embodiment is formed of two wires it may be formed by folding one wire into two, or made of synthetic resin by moulding so that the stimulating elastic members 72 are planted radially around the core 71 in one body. It is preferred to determine the length of the core 71 to about 8cm to 12cm.

The stimulating elastic member 72 needs at least 11cm in length, so that the gastric resident object 7 admitted into the rumen can be positioned in the rumen so as not to be sent backward into the mouth through the cardiac orifice and the gullet, or sent beyond the psalterium. Therefore, the stimulating elastic member should have the length of 11cm or more. However, it have been found from the experiment conducted later that a tolerance of about 3cm in length of the stimulating elastic member can be allowed.

Since the gastric resident object 7 cannot be admitted into the rumen as it is, it should be made small in diameter. To make the gastric resident object small in order for permitting the gastric resident object to pass through the gullet smoothly, it may be inserted into a slender paper cylinder 1 with the stimulating elastic members 72 folded elastically along the core 71. The diameter of the paper cylinder 1 may be determined to 2.5cm to 3.5cm.

It may be advantageous to cover both ends of the paper cylinder 1 accommodating the gastric resident object 7 with metallic or plastic caps 6 as occasion calls, thereby to prevent the walls of the gullet from being injured when admitting the gastric resident object into the rumen.

The paper cylinder 1 is made by spirally rolling an inner base 2 to form an inside tube and spirally winding an outer strip 4 around the inside tube with defining a gap 5 between the confronting side edges of the strip 4. The outer strip 4 wound in a cylinder shape is pasted with an adhesive soluble in gastric juices in the rumen. It is preferable to determine the length of the paper cylinder 1 to about 12cm to 16cm because if the paper cylinder 1 is too long, it cannot easily be admitted into the rumen.

The paper cylinder 1 is guided into the pharynx by use of a long tube to let the cattle swallow it. Thus, the paper cylinder 1 accommodating the gastric resident object can be introduced into the rumen. Then, the pasted part of the paper cylinder 1 is dissolved within five to ten minutes to break up the paper cylinder, thereby to allow the stimulating elastic members 72 to regain their original spiny shape.

With movement of the rumen, the gastric resident object moves from place to place in the rumen. At that time, the gastric resident object comes in contact with the mucous membrane of the rumen to stimulate a peripheral part in the reticulum, thus promoting rumination. Simultaneously, the inner wall of the rumen acquires physical stimuli, to stimulate the receptors innumerably distributed under squamous cells in the mucous membrane of the rumen, thus wholesomely preserving ruminal papillae. Furthermore, the stimulating elastic members 72 of the gastric resident object have a function of catching small fragments of the feed in which microorganisms are snug.

In order for effectively moving the gastric resident object 7 to encourage rumination, it is necessary to prevent the gastric resident object from rising to the surface of the feed in the rumen and going down to the lower wall portion of the rumen. That is, the gastric resident object should freely move in the rumen. For that purpose, it is desirable to use the gastric resident object 7 with a specific gravity of the order of 0.2~0.5, because the specific gravity of the gastric resident object with the fragments of feed crept in the stimulating elastic members 72 is suitably 1.2~1.3.

It is preferred that two to six gastric resident objects 5 as noted above are positioned in the rumen.

[EXPERIMENTAL EXAMPLE 1]

1. Testing Place: Kamewari farm, Shimojo Agricultual Cooperative Association of Japan
2. Testing Period: For six months from 15th May, 1992 to 15th November, 1992.
3. Cows under experimental test:

TABLE 3

Type	Cow No.	Birth Date	Natal Times	Postpartum Milking (Max: kg)	Last Child-birth
Testing Cows *	1	2/2/89	2	34.0	16/3/92
	2	7/5/87	4	36.2	24/12/91
Comparative Cows	3	25/2/89	2	31.4	21/3/92
	4	12/5/87	4	37.0	4/12/91

Remarks (*).. Testing cows provided with three gastric resident objects.

4. Results of Milk Secretion (approved):

TABLE 4

Items	Testing Cows	Comparative Cows
Milk secreted (kg)	32.3±2.8	31.8±4.2
Cream Content (%)	3.3±0.4	3.4±0.2
SNF (%)	0.77±0.48	8.65±0.22
FCM (%)	29.0±3.5	28.1±3.4
Rough Efficiency (%)	33.5±2.1	32.3±2.4

5. Feed Components:

TABLE 5

	Feeding Amount per day (kg)	
	Testing Cows	Comparative Cows
Compound Feed Fiber 72	14.5	14.0
Processed Barley Distillers Grain with Soluble (Wet)	6.5	3.5
Beat Pulp	1.0	1.0
Barley	1.0	1.0
Rice Straw	0	2.0
Dry Grass	2.2	4.0
Number of Gastric Resident Objects	3	0

TABLE 6

Ratio of Feed to Required Amount *	Testing Cows	Comparative Cows
DM	94.4%	105.5%
DCP	131.4%	118.2%
TDN	105.6%	104.8%
Ratio of Minimum Crude Fiber	101	142

* Required amount calculated according to Japanese Feeding Standards (1987)

6. Gastric Juices / Serums:

TABLE 7

		Testing Cows	Comparative Cows
Intra-gastric Conditions	pH	6.6	6.6
	Ammonia-denatured nitrogen (mg/dl)	19.6	19.2
VFA Compositions (mol.%)	Acetic Acid	58.8	59.1
	Propionic Acid	24.0	23.7
	Butyric Acid	15.1	14.9
	Ratio of Acetic Acid to Propionic Acid	2.4	2.5
Serums	TP g/dl	7.7	8.0
	AIb g/dl	3.4	3.2
	A/G	0.8	0.7
	BUN mg/dl	21.4	20.0
	Ca mg/dl	10.4	10.3
	P mg/dl	5.1	4.7

It has been proved from the above that, by using three gastric resident objects admitted into the rumen and increasing the compound feed, the yield of milk secreted and milk contents are little affected even if the amount of the long fibers constituting a rumen mat that the milking cow ingests is reduced by half.

[EXPERIMENTAL EXAMPLE 2]

Test for milk secretion in use of the gastric resident object was conducted at Oyata Dairy Area of Shimojo-mura, Shimoina-gun, Nagano-ken, Japan.

TABLE 8

Experimental Items	Testing Cow (1)						
	The year of 1991						
	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Milk Secretion (kg)	24.5	27.8	26.5	26.4	28.1	28.7	27.1
Cream Content (%)	3.34	3.36	3.37	3.35	3.34	3.24	3.35
Protein Content (%)	3.11	3.12	3.14	3.18	3.16	3.17	3.11
Nonfat Solids (%)	8.62	8.57	8.62	8.54	8.62	8.61	8.54
Body Weight (kg)	645	640	640	645	650	650	655
Compound Feed Supplied (kg)	9.3	9.3	9.1	9.2	9.6	9.7	9.6
Roughage Supplied (kg)	6.5	7.0	5.4	5.3	5.5	5.4	5.3

TABLE 9

Experimental Items	Testing Cow (2)					
	The year of 1992					
	Jan.	Fev.	Mar.	Apr.	May	Average
Milk Secretion (kg)	26.7	27.2	28.6	28.1	26.2	27.16
Cream Content (%)	3.41	3.38	3.36	3.28	3.22	3.32
Protein Content (%)	3.09	3.12	3.14	3.17	3.16	3.14
Nonfat Solids (%)	8.58	8.67	8.61	8.59	8.54	8.59
Body Weight (kg)	655	650	655	650	645	648.3
Compound Feed Supplied (kg)	9.7	9.4	9.6	9.5	9.8	9.48
Roughage Supplied (kg)	5.5	5.4	5.1	6.4	6.2	5.75

TABLE 10

Experimental Items	Comparative Cow (1)						
	The year of 1991						
	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Milk Secretion (kg)	22.8	23.2	24.6	25.2	26.3	25.3	25.5
Cream Content (%)	3.31	3.31	3.28	3.38	3.31	3.42	3.34
Protein Content (%)	3.12	3.16	3.09	3.11	3.12	3.17	3.18
Nonfat Solids (%)	8.59	8.68	8.72	8.66	8.71	8.68	8.63
Body Weight (kg)	650	645	640	640	650	645	655
Compound Feed Supplied (kg)	7.8	7.7	7.7	7.6	7.7	7.9	7.8
Roughage Supplied (kg)	7.5	8.0	8.5	8.0	8.7	8.3	8.4

TABLE 11

Experimental Items	Comparative Cow (2)					
	The year of 1992					
	Jan.	Fev.	Mar.	Apr.	May	Average
Milk Secretion (kg)	24.1	23.9	25.5	26.1	23.3	24.65
Cream Content (%)	3.46	3.43	3.24	3.22	3.21	3.23
Protein Content (%)	3.12	3.11	3.17	3.14	3.09	3.13
Nonfat Solids (%)	8.68	8.72	8.68	8.56	8.57	8.66
Body Weight (kg)	645	650	655	645	650	647.5
Compound Feed Supplied (kg)	7.7	8.1	8.4	8.0	7.8	7.85
Roughage Supplied (kg)	8.3	7.8	7.9	8.2	8.1	8.12

Remarks 1 : Milking cows resemble in age, childbirth experience, date of childbirth, ability and body weight were used in the test and segregated to groups of closely resemble cows as the testing cows and comparative cows. The groups of the testing and comparative cows were each composed of ten cows. The age of the testing cows averaged 4.2 years, and that of the comparative cows averaged 4.3 years. The average number of times of childbirth of them was 2.8.

Remarks 2 : The experimental test was carried out from 1st June 1991 to 31st May 1992. The period for 2 months from the commencement of the test to 1st August 1991 was spared for a preparatory test. Upon termination of the preparatory test, three gastric resident objects were supplied to the respective testing cows.

Remarks 3 : The feed for cattle prepared by the Japanese Agricultual Cooperative Association was used as concentrate. The roughage consisting of timothy hay, alfalfa hay cube and rice straw were used. Further, Sudan grass hay and silage which have the weight calculated on the basis of air dry matter were added to the feed.

Remarks 4 : After applying the gastric resident objects to the testing cows, the fibrous feed except the Sudan grass hay and rice straw was supplied to the testing cows.

It is evident from the above tables exhibiting the experiment results that the milk secretion of the milking cows do not receive an influence from long fibers such as Sudan grass hay and rice straw by applying three gastric resident objects and giving partially fibrous feed to the milking cows.

[EXPERIMENTAL EXAMPLE 3]

Comparative results of the yields of milk secreted by milking cows to which the gastric resident objects were administered before and after childbirth are denoted in FIG. 4. (Test conducted at the farm "A" of Higashitayoro-cho, Hokkaido, Japan) FIG. 4, the daily average amount of the milk secreted by three milking cows that were delivered in the same month was recorded by mont h.

[EXPERIMENTAL EXAMPLE 4]

FIG. 5 shows the comparative results of the yields of milk secreted by the milking cows with the gastric resident objects administered before and after childbirth. (Test conducted at the farm "A" of Higashitayoro-cho, Hokkaido, Japan)

[EXPERIMENTAL EXAMPLE 5]

The results of testing the yields of milk secreted by milking cows with the gastric resident objects administered in hot summer days are shown in FIG. 6. (Test conducted at the Shiokawa farm of Fujinomiya-shi, Shizuoka-ken, Japan)
Testing Period : 15th April 1992 to 15th October 1992. In the experimental test, twenty-eight (28) milking cows with the gastric resident objects administered and thirty (30) milking cows with no gastric resident objects administered were respectively segregated into the testing cows and the comparative cows by three cows resemble in age, body build, date of childbirth, childbirth experience, and ability of milk secretion. While recording the yield of milk secreted by the cows, the monthly yield of milk secreted after June was compared with the yield of milk secreted on 5th April 1992, observing the decrease in milk yield (average). (Three gastric resident objects were administered.)

[EXPERIMENTAL EXAMPLE 6]

The change in milk yield when using the gastric resident objects is depicted in FIG. 7. (Test for decline in milk yield in summer and endurance against warmth was carried out at the farm "S" of Nozu-cho, Ohno-gun, Oita-ken, Japan for the period from January to February 1991 by use of milking cows after childbirth. Three gastric resident objects were administered to the respective cows.

[EXPERIMENTAL EXAMPLE 7]

The experimental test for evaluating the effect of the gastric resident object capable of preventing the decline in milk yield in the scorching heat of summer was conducted at the farm "S" of Nozu-cho, Ohno-gun, Oita-ken, Japan. Three cows were chosen as the testing cows from thirty-five (35) cows with the gastric resident objects administered, and three cows were chosen as the comparative cows from thirty-one (31) cows with no gastric resident object administered. Individuals thus chosen were further assorted into two groups in pairs resemble in age, body build, ability of milk secretion, date of childbirth (January or February 1991), and childbirth experience. The average of the yield of milk secreted by three cows was recorded and depicted in FIG. 8. Three gastric resident objects were administered to the respective cows.

Owing to the gastric resident objects administered to the milking cows, the marked decrease in milk secretion when the scorching heat of summer can be prevented. Upon performing the tests for evaluating the gastric resident objects in the districts of Hokkaido, Shizuoka and Kyushu of Japan, the same adequate results could be obtained in these three districts.

[EXPERIMENTAL EXAMPLE 8]

The experimental tests for confirming the effect and safety of the gastric resident objects administered to the fat cows were carried out at 25 farms all over Japan from October 1988 to October 1991. The experimental results obtained by accumulating postmortem data and grading data of carcasses of 637 cows selected from a total of 4728 cows are shown in TABLE 12 below.

TABLE 12

Number of farms under test	Number of Testing Cows	Increase in weight during milking emasculation	Death due to gastic resident object	Fleshy substance
	Milk-emasculated 507 F1 79 Japanese cattle 51 Total 637	1256	0	Total* B4 95(16.2%) B3 218(37.2%) B2 273(46.6%)

*..Total of milk-emasculated cows and F1 cows

Of the 4728 milking cows provided with the gastric resident objects according to the invention, no cow was killed due to the gastric resident objects administered thereto. Since about 1.1 kg of long fabric feed such as straw and hay was not required a day on average throughout the testing period as is evident from Table 12, 320 kg of feed in total could be curtailed.

The cows made a gain of 1.25 kg in weight per day on average. This means that a standard milking cow would gain weight by 1.2 kg or more a day.

The result of the grading test of carcasses shows that the milk-emasculated cows and F_1-cows were classified into as 16.2% of B-4, 37.2% of B-3, and 46.6% of B-2. The Japanese cattle were classified into 82% of A-5, and 18% of A-4 and B-4.

The cows raised according to the invention made no great difference in weight increase to the cow raised in an ordinary fatting method, and had no accident due to the gastric resident objects during the test. This sign that the condition of the ruminant stomach could be maintained appropriately.

An examination of the result of the grading test, the resultantly obtained carcasses which were classified into 16.2% of B-4 and 37.2% of B-3 are considered to be equal or superior to the cattle rank standardized by Japan Meet Ranking Cooperative Association prescribing the ranking number of livestock (1990) according to which the raised cows should contain 3.5% of B-4 and 35.5% of B-3.

According to the present invention, by using and positioning the gastric resident object having stimulating elastic members in the rumen of dairy cattle, the fiber content in feed for cattle can be reduced while increasing the total intake energy the cattle ingests, and the rate of acetic acid in VFA can be preserved, thereby keeping the quality of secreted milk. Besides, the gastric resident object admitted into the rumen of the cattle which has a function of rough rigidity of roughage for giving physical stimuli to the rumen can be substituted in part for the feed to be given to the cattle, thus promoting rumination.

Also, it is evident from the results shown in the aforementioned Experimental Example 8 that the effect of the gastric resident object has a function of fattening up the dairy cattle. This means that the physical stimulus brought about by fibrous feed rich in Class-Ob content can be replaced with the gastric resident object according to the invention, and fibrous feed rich in Class-Oa content can be supplemented with other feed.

Accordingly, the various problems posed in feeding roughage to the dairy cattle can be solved so as to reduce the cost of feeding, let the cattle have dry matters, thus increasing milk secretion and NEp value. Moreover, the volume of excrement can be decreased.

A marked increase of VFA in the rumen which decreases feed intake thus possibly bringing about a disease of digestive organs can be suppressed by feeding even roughage to the cattle moderately without being partial to decomposable feed, and VFA can be naturally increased. As a result, prevention of decrease in milk secretion and improvement in milk quality can be achieved at a low cost with remarkable ease without any other troublesome feeding work.

Claims

1. A device for improving milk secretion which includes a gastric resident object (7) comprising a core (71) and stimulating elastic members (72) extending radially from the core.

2. A device as claimed in claim 1, wherein the core is formed by twisting together two wires between which are held the stimulating elastic members (72).

3. A device as claimed in claim 1 or 2, wherein the stimulating elastic members (72) are nylon fibers.

4. A device as claimed in claim 1, 2 or 3, wherein the gastric resident object (7) has a diameter of about 8cm to 14cm when the stimulating elastic members (72) are expanded.

5. A device as claimed in any one of claims 1 to 4, further comprising a paper cylinder (1) for accommodating said gastric resident object (7), said paper cylinder being formed by spirally winding a strip (4) around an inner tube (2) with defining a gap (5) between the side edges of the strip.

6. A device as claimed in claim 5, wherein the paper cylinder (1) has end caps (6).

7. A device as claimed in claim 5 or 6, wherein the outer strip (4) is adhered to the inner tube (2) by means of an adhesive soluble in gastric juices.

8. A device for improving milk secretion of cattle comprising positioning in the rumen of the cattle one or more resident objects as claimed in any one of claims 1 to 7, thereby to restrain dietary fiber content in feed and preserve the rate of acetic acid in VFA.

9. A method of decreasing volume of excrement from cattle comprising positioning in the rumen of cattle one or more gastric resident objects as claimed in any one of claims 1 to 7.

FIG.1

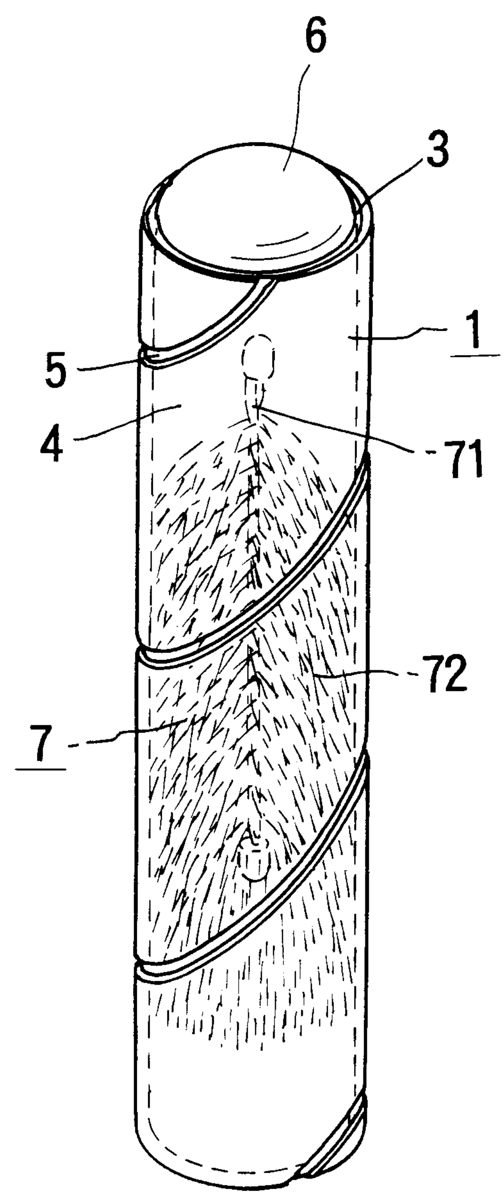


FIG. 2

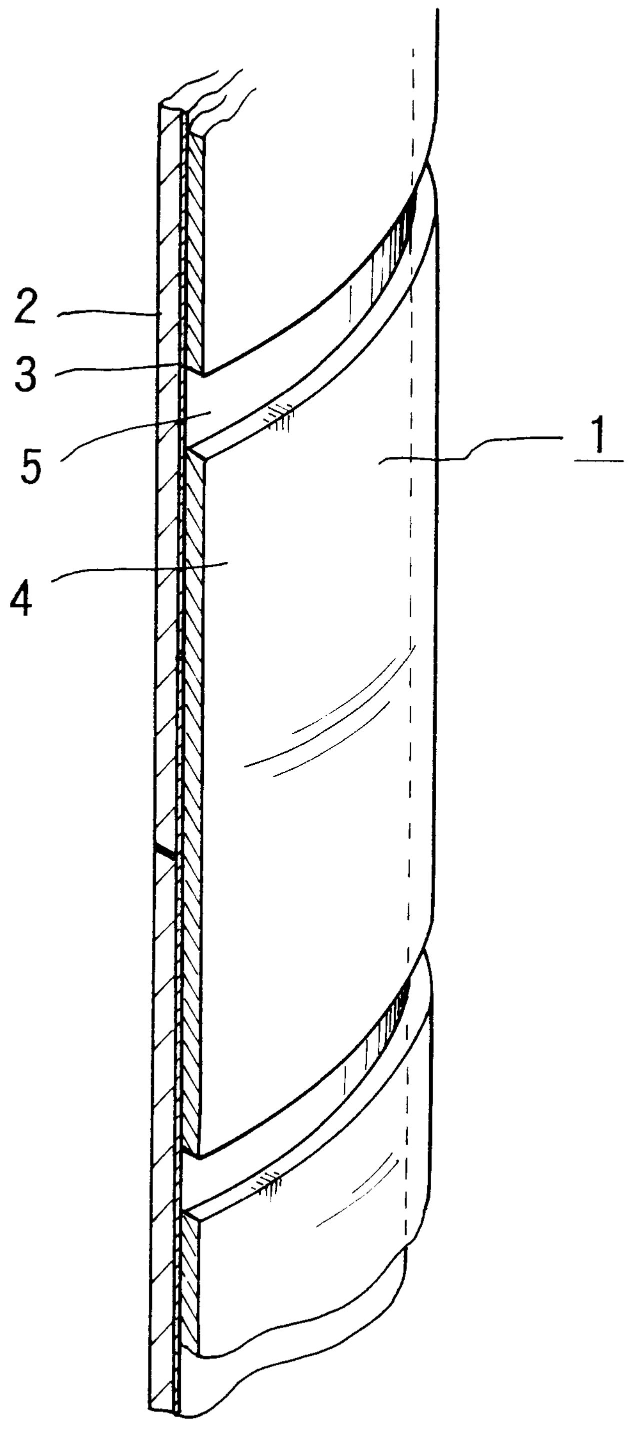


FIG. 3

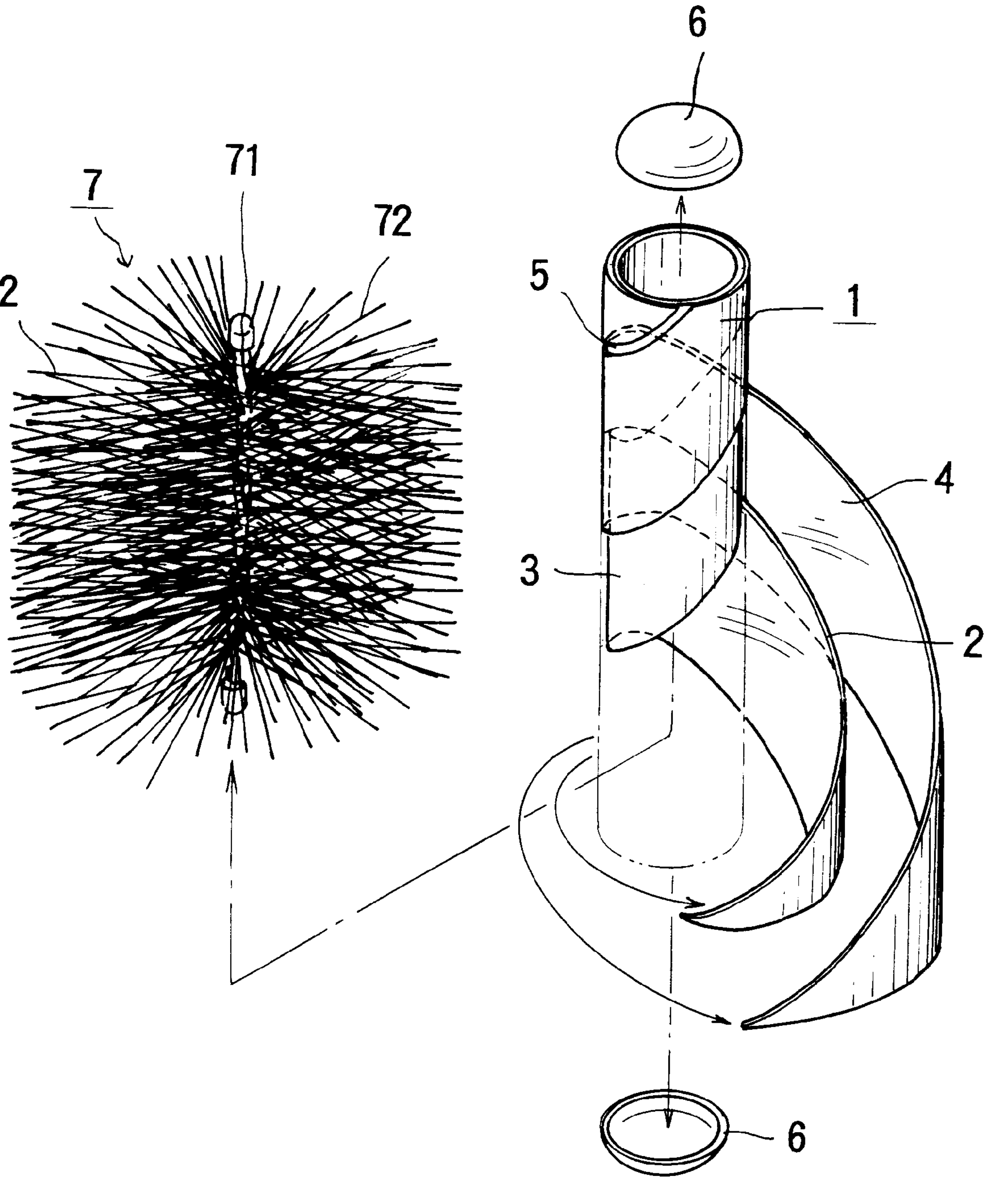
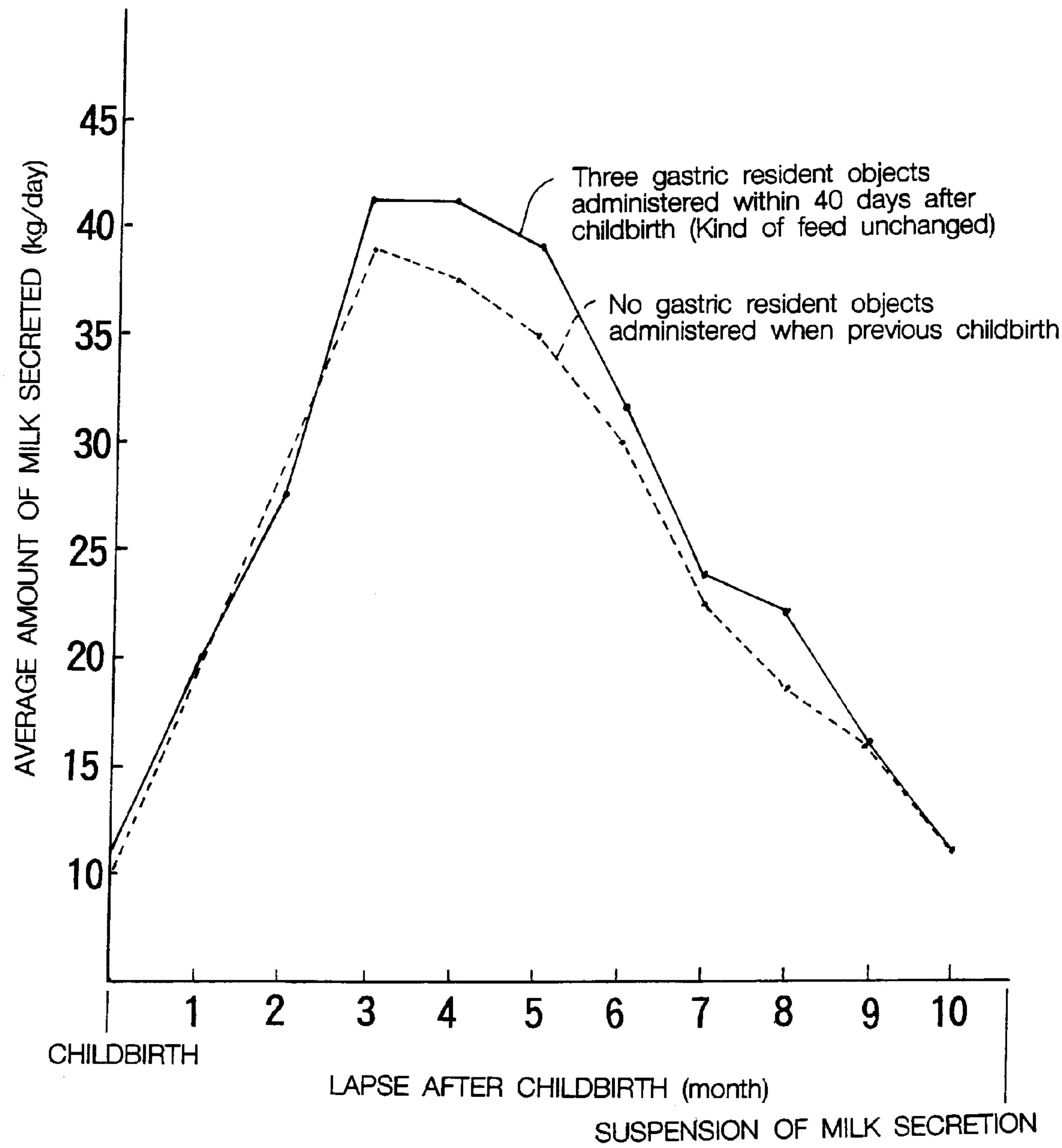


FIG.4



45
40
35
30
25
20
15
10
AVERAGE AMOUNT OF MILK SECRETED (kg/day)
Three gastric resident objects administered within 40 days after childbirth (Kind of feed unchanged)
No gastric resident objects administered when previous childbirth
1 2 3 4 5 6 7 8 9 10
CHILDBIRTH
LAPSE AFTER CHILDBIRTH (month)
SUSPENSION OF MILK SECRETION

FIG.5

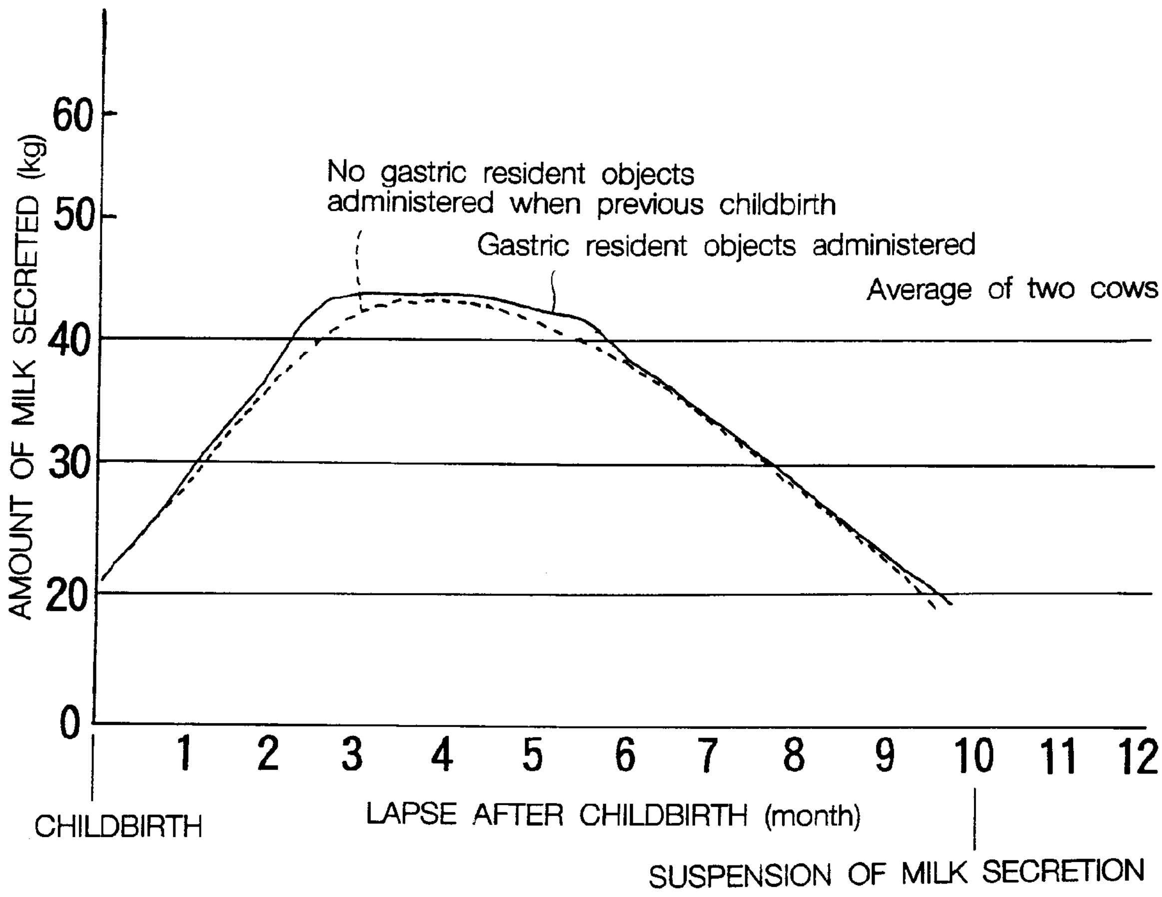

AMOUNT OF MILK SECRETED (kg)
60
50
40
30
20
0
No gastric resident objects
administered when previous childbirth
Gastric resident objects administered
Average of two cows
1 2 3 4 5 6 7 8 9 10 11 12
CHILDBIRTH
LAPSE AFTER CHILDBIRTH (month)
SUSPENSION OF MILK SECRETION

FIG. 6

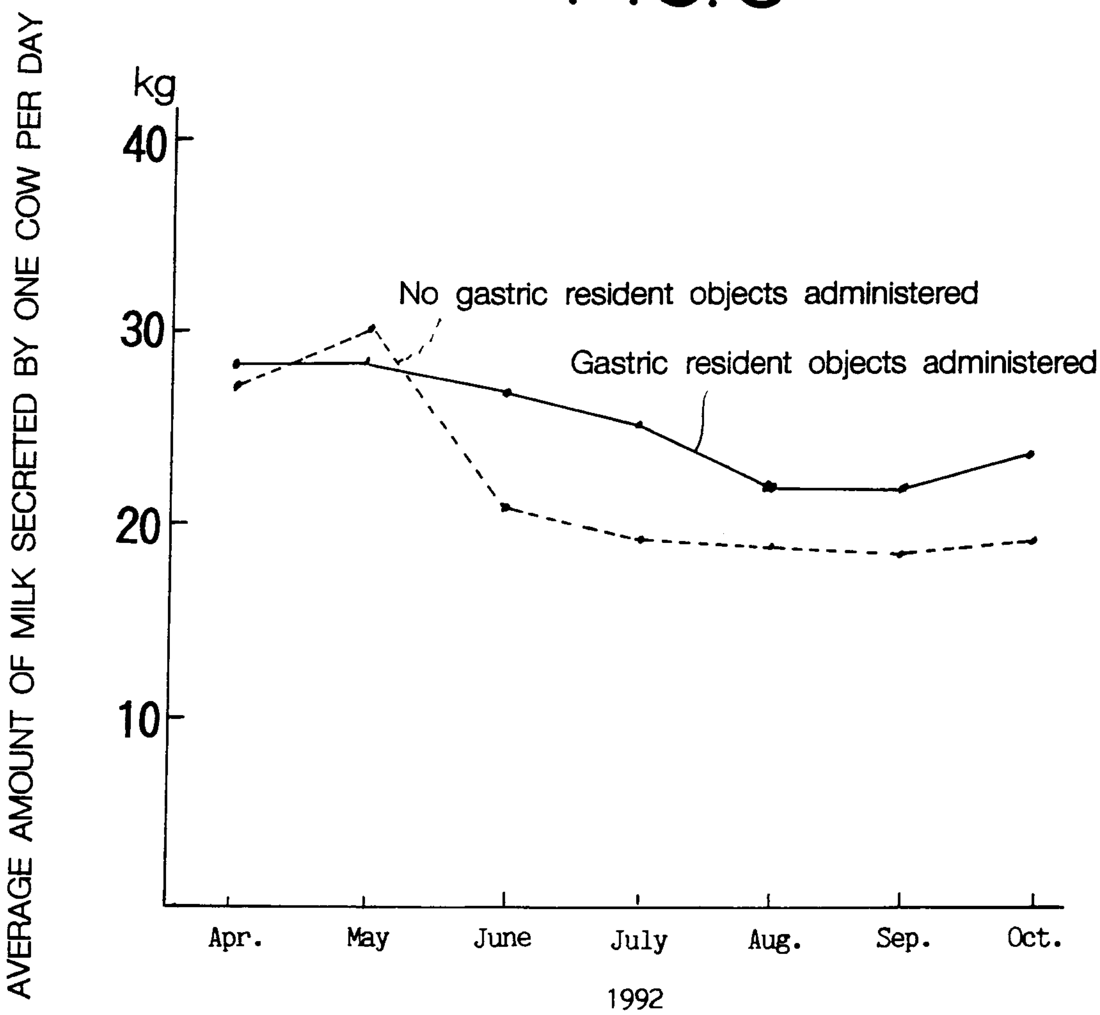

AVERAGE AMOUNT OF MILK SECRETED BY ONE COW PER DAY
kg
40
30
20
10
No gastric resident objects administered
Gastric resident objects administered
Apr.
May
June
July
Aug.
Sep.
Oct.
1992

FIG.7

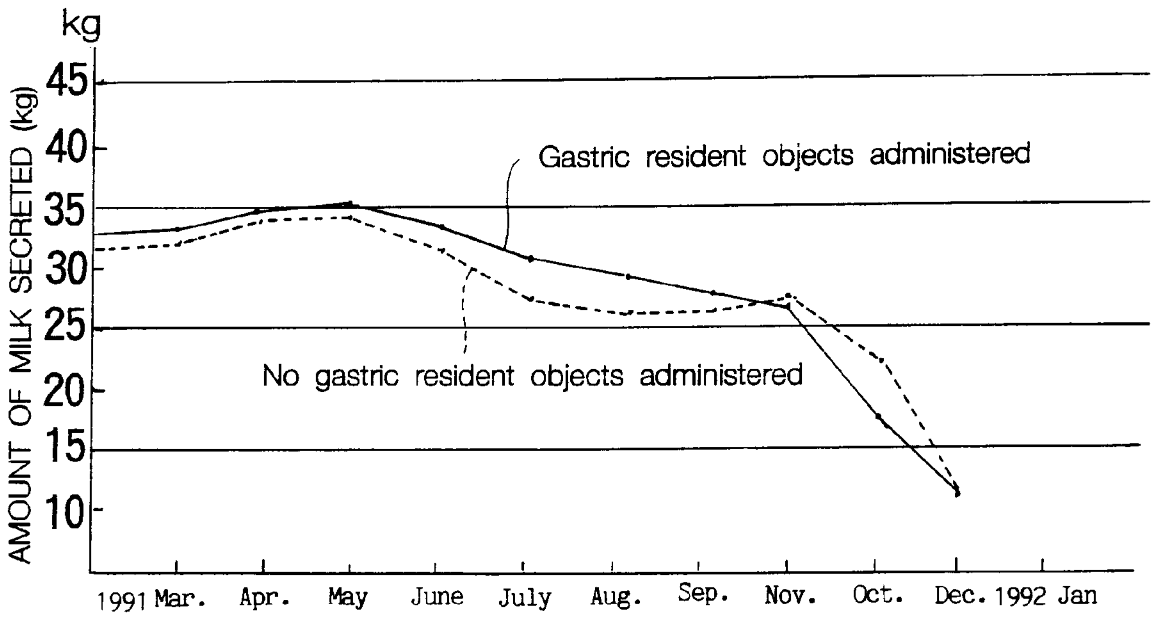
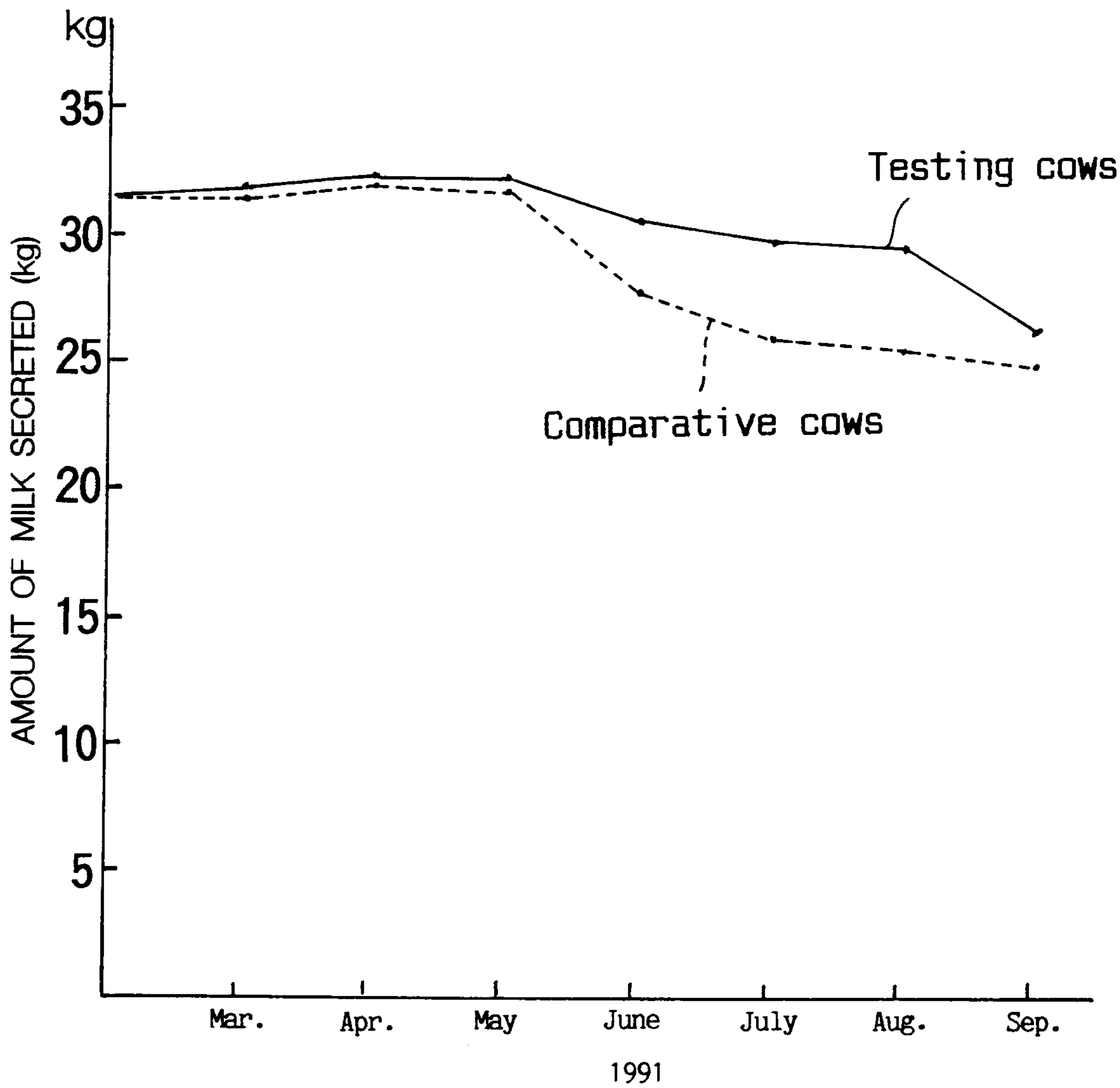

kg
AMOUNT OF MILK SECRETED (kg)
45
40
35
30
25
20
15
10
Gastric resident objects administered
No gastric resident objects administered
1991 Mar.
Apr.
May
June
July
Aug.
Sep.
Nov.
Oct.
Dec. 1992 Jan

FIG.8


kg
35
30
25
20
15
10
5
AMOUNT OF MILK SECRETED (kg)
Testing cows
Comparative cows
Mar.
Apr.
May
June
July
Aug.
Sep.
1991